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# ***FOREST RESEARCH***

***AND***

# ***INDIAN INDUSTRY***

***The work of the  
Forest Research Institute  
at Dehra Dun  
and  
its Utility to  
Government Departments  
and Industrialists  
in India.***



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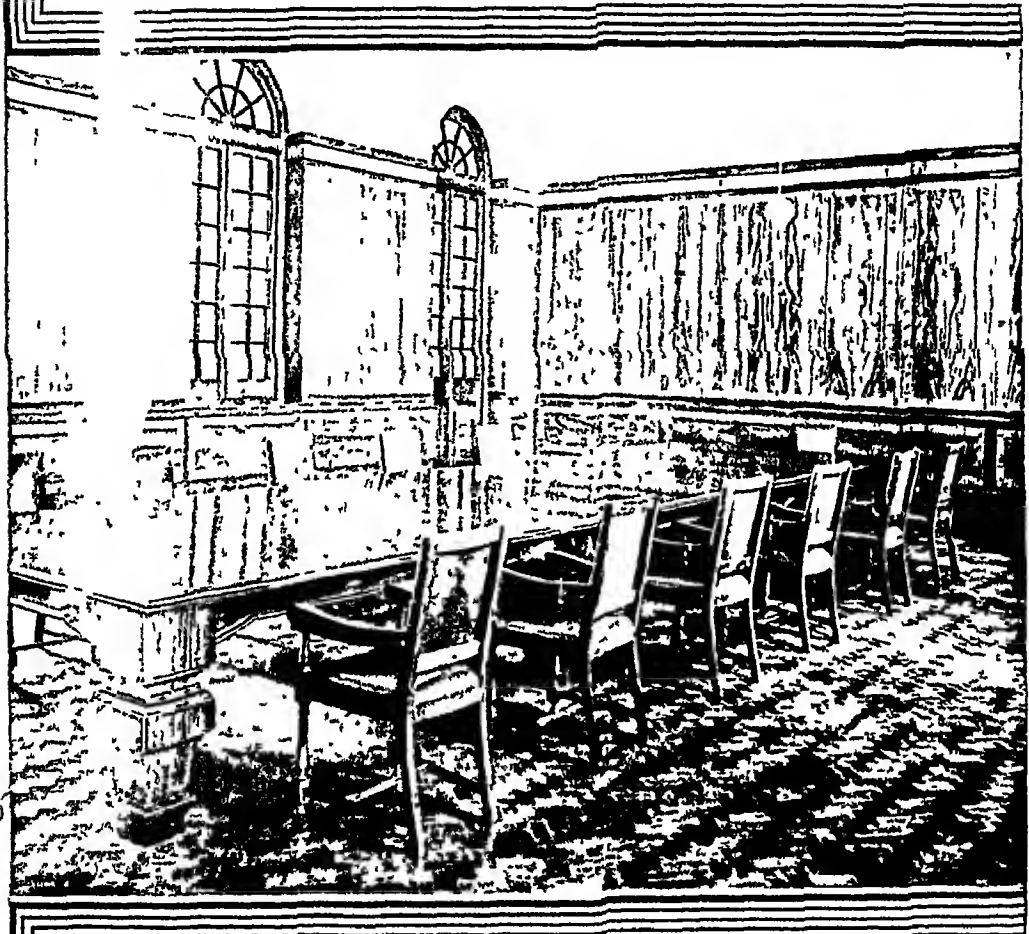
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# CHOICE INDIAN TIMBERS FOR INTERIOR WORK



## THE BOARD ROOM AT THE FOREST RESEARCH INSTITUTE

The walls are panelled with figured laurel (*TERMINALIA TOMENTOSA*)  
sawn veneers on laminated cores.

The table is of Andaman-padauk (*PTEROCARPUS DALBERGIOIDES*).

The chairs are of Burma padauk (*PTEROCARPUS MACROCARPUS*).

The parquet flooring is of kyana (*CARAPA MOLUCCENSIS*).

Designed and executed in the Wood Workshops of the Forest Research Institute.

# FOREST RESEARCH AND INDIAN INDUSTRY.

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THE FOREST RESEARCH INSTITUTE at Dehra Dun has been carrying on research for some thirty years into the processes of growing trees and of making profitable use of timber and other produce of forests. The applied research of a business which is concerned with problems arising from the production of raw material, as well as from its manufacture and utilization in industry, must necessarily involve many branches of science. Experts are employed at Dehra Dun to conduct research in Silviculture, Botany, Mycology, Forest Protection, Entomology, Biochemistry, Forest Economy, Wood Technology, Timber Seasoning, Preservation and Testing, Wood-working and Minor Forest Products including Paper Pulp.

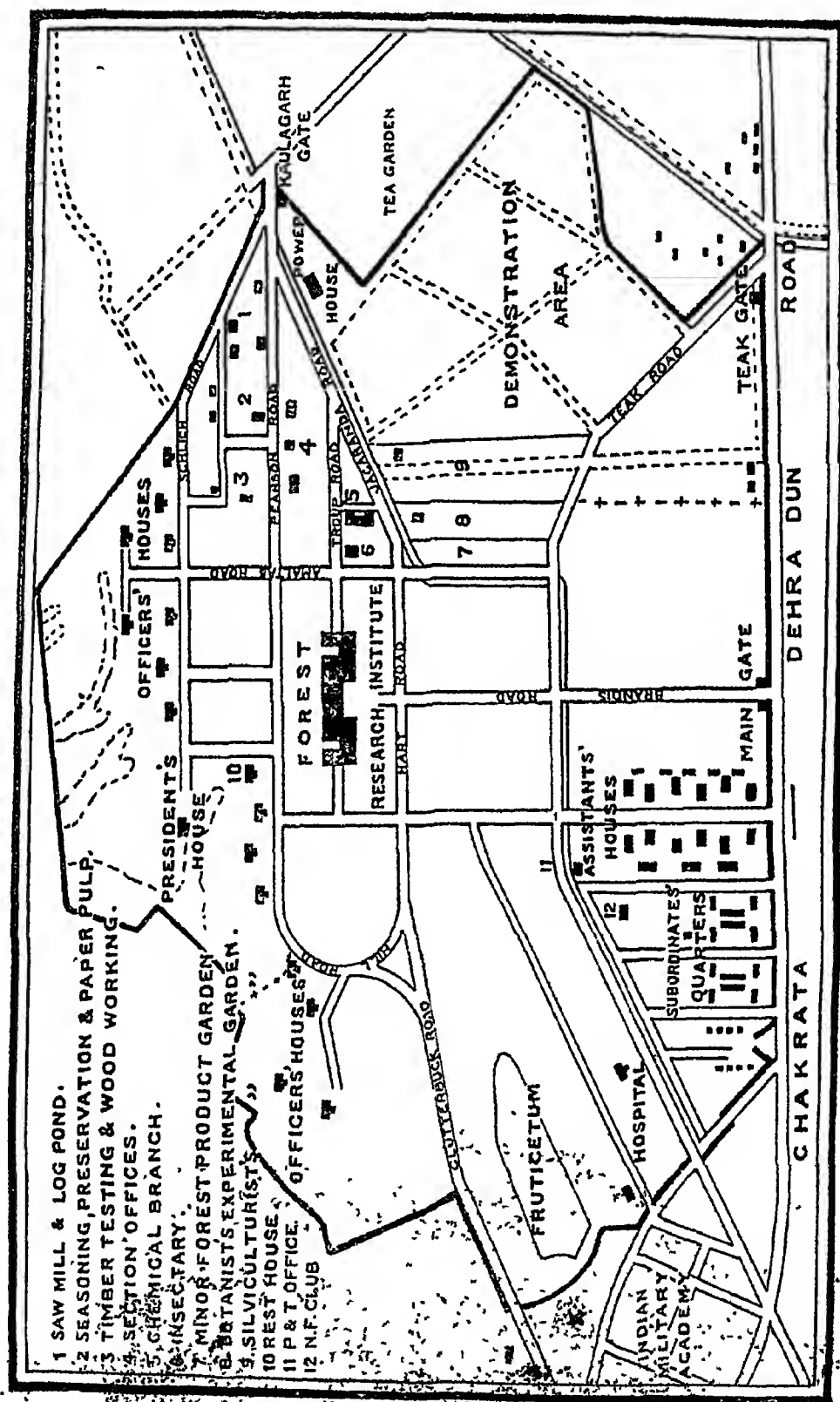
The work of each expert is devoted to a particular field of production or utilization, but is nevertheless closely related to the work of other experts. This interrelationship should be readily appreciated by reference to the diagram on page 3 overleaf.

The Institute was founded primarily for the benefit of the Indian Forest Department for which it has produced abundant results of acknowledged economic value. These results are recorded elsewhere.

The present account deals with another aspect of the activities of the Institute, — the extent to which it is of use to other government departments such as the Railways and Army, to Indian States and to industrialists concerned with the utilization of timber and forest produce.



# PLAN OF NEW FOREST ESTATE.



## THE SCOPE OF RESEARCH IN FORESTRY.

A glance at the diagram below gives you a birdseye view of the interrelationship of the various sections of forest research from the cultivation of the tree to the utilization of timber and other products of forestry. This is the view-point from which our survey of the more important results of research in each section is planned; and for ease of reference to particular subjects there is list contents at the beginning.

DIRECTION OF FOREST RESEARCH President		
THE GROWING TREE	TIMBER AND WOOD USING INDUSTRIES	FOREST PRODUCE OTHER THAN TIMBER
PLANTATION CULTIVATION AND YIELD Silviculturist	UTILIZATION Economist	VEGETABLE OILS FIBRES, DRUGS etc %Minor Forest Products Biochemist
IDENTIFICATION Botanist	IDENTIFICATION Wood Technologist	
PROTECTION Silviculturist Entomologist Mycologist	TESTING AND USES %Timber Testing %Wood Workshops	PAPER AND CELLULOSE PRODUCTS %Paper Pulp
	SEASONING AND PRESERVATION %Timber Seasoning %Wood Preservation Entomologist	

## 1. RESEARCH ON THE GROWING TREE.

### SILVICULTURAL RESEARCH.

The practical results of silvicultural research are primarily of value to Provincial and State Forest Departments, but many of them are useful to private forest owners and to business concerns which extract timber from government forests.

### MAINTENANCE AND EXPLOITATION OF FORESTS.

Felling and extraction of timber is almost entirely undertaken by private enterprise. For satisfactory organisation of this work a contractor needs to estimate the volume of timber which can be

obtained from trees of different dimensions. The Forest Research Institute has collected the information he requires by careful measurement of a large number of trees of all important species and by compilation of average figures in the form of volume tables.

To determine the most profitable size and age at which to fell

Data on yield and the different kinds of trees and forest crops volume.

the owner must know their particular rates of growth and yield. This knowledge is obtained by Silviculturists from periodic measurements on about 1,800 sample plots of forests in various parts of India. The most profitable method of cutting bamboos for paper pulp and general consumption is another silvicultural problem on which much work is in progress in the interests of the industries concerned.

#### PLANTATIONS.

Silvicultural research is constantly at work on important

problems connected with the regeneration and tending of forests, and the reduction of

the costs of these operations. Plate 2 shows the results of research on regeneration by artificial methods as applied to a teak plantation. Planting out teak stumps six weeks before the break of the rains in certain localities caused so marked a gain in the growth and survival per cent in the first year that weeding and connected expenses were reduced by Rs. 5 to Rs. 12 per acre.

Extensive research has determined which are the most suitable

species for plantations with different objectives in different soils and climates, and

Suitable trees for plantations. this experience has helped silviculturists to meet the frequent enquiries from private landowners, municipalities and cantonments. Investigations similar to those that have improved wheat and sugarcane for agriculture are undertaken by the Silviculturist to isolate strains that are particularly productive of such commodities as pine resins, solid bamboos and myrobolans, as well as strains of superior value for timber production.

The supply of authentic seeds of trees and other plants of economic importance for cultivation or for

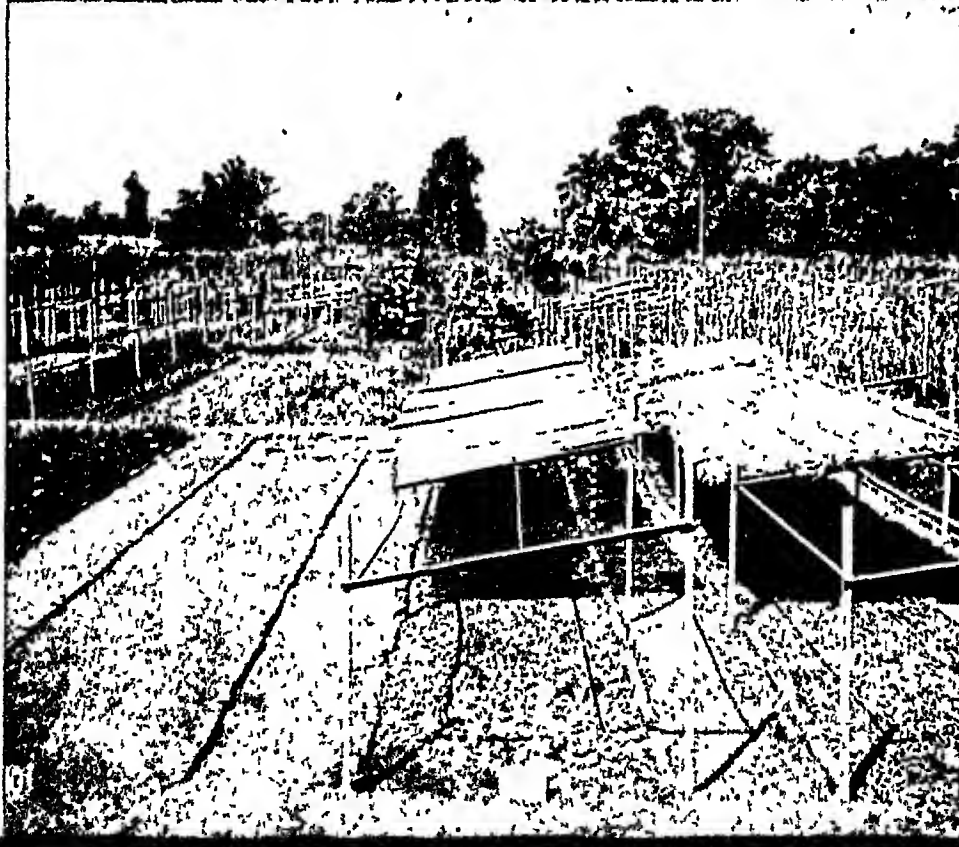
Seed supply. the formation of plantations is a constantly recurring demand that is met by the Forest Botanist.

#### SOIL EROSION AND GRAZING.

Soil conservation, the reclamation of eroded lands, the prevention of landslips and inatter, of importance

Help for other to the inhabitants of districts adjoining forests come within the scope of silviculturists, and their help has frequently been obtained by departments.

SILVICULTURE



### SILVICULTURE

**ABOVE:** A teak plantation raised by early stump planting, showing the growth obtained in 51 months. This height growth is greater than that usually obtained in one year from normal monsoon planting.

**BELOW:** Portion of a silvicultural nursery at the Forest Research Institute used for raising stock for planting experiments and for determining the best nursery technique to adopt for different species of trees.



Revenue Departments and others concerned with the needs of the cultivator. They are similarly called on by the Revenue, Agricultural and Animal Husbandry Departments to investigate the improvement of forest grazing and fodder supplies.

#### COORDINATION OF SILVICULTURAL RESEARCH.

Centralised direction is required for most of the heavy statistical work involved in these investigations, for the initiation and coordination of research on problems affecting several provinces, for the development of special research methods, and for the scrutiny of the forestry and associated literature of all countries to obtain information of value to India. This coordination of silvicultural research is undertaken by the Silviculturist at the Forest Research Institute; its practical value is demonstrated

by periodical silvicultural conferences, the most recent of which was attended by 42 gazetted officers including representatives of States and Irrigation Departments.

#### REMEDIES FOR PESTS AND DISEASES.

Insect pests increase the difficulties and costs of forming plantations, or reduce the yield by defoliating and boring the living tree, or threaten the very existence of a forest, but they *can* be checked by using the proper control measures at the right time. The Forest Entomologist studies the life-histories of pests in insectaries (see Plates 6 and 9) or on the spot, and investigates the possibilities of control by direct artificial measures or by natural processes—the latter involving modifications of cultural practice or the use of parasites and other natural enemies of the pest.

The control scheme for the sal borer is probably the most effective and best organised of any devised for forest protection. Since the scare caused by the big epidemics in central and north India ten years ago, when over sixty lakhs of trees were killed, the forest departments of the States and the Provinces have adopted the standard measures and can testify from experience that potential losses of several million rupees have been prevented at relatively insignificant cost. These are reliable estimates—not guesses.

The Indian States rely largely on the Dehra Dun Institute for help with their insect pest troubles, and have benefitted from all the research that has been done on pests common to British India and their own territories. Advice has also been given to agricultural departments, fruitgrowers and landowners in connection with pests of avenue trees and orchards.

The dissemination of cochineal insects for the destruction of prickly pear has cleared large tracts of country of this noxious weed. This phenomenal success has aroused interest in the possibilities of dealing with other weeds by similar methods.

Entomological research at Dehra Dun discovered a remedy for interruptions on the high tension lines of a provincial hydro-electric scheme which were caused by swarming flies.

An outstanding example of productive teamwork is the survey of the insect fauna of sandal and the search for a vector of the spike disease which were undertaken in conjunction with the Coorg, Madras and Mysore governments and the Indian Institute of Science. Spike disease has killed off sandal trees valued at over two crores of rupees and the mode of infection has remained a mystery for thirty years. It is now known that the disease, which is due to a virus, is carried by a sapsucking insect.

The **Mycologist** has studied many root and stem diseases, rusts and leaf-shedding fungi that affect trees and has prescribed measures for their control.

### CORRECT IDENTIFICATION OF PLANTS, INSECT PESTS AND DISEASES.

Industry is entirely dependent on scientific authority for the accurate naming of plants, trees, insect pests and diseases, and various forest products.

The identification of forest trees and plants is done by the **Forest Botanist** who maintains for this purpose a **Herbarium**, containing about a quarter of a million plant specimens. He has also built up a collection of fruits and seeds, an **Arboretum** and **Botanical Garden** in which trees, shrubs and climbers are grown for research purposes. The

**Naming of plants.** systematic botany organised at Dehra Dun has been of great value in the preparation of local floras and its records have been used by numerous field botanists. Research on the varieties and distribution of plants of commercial utility (see Plate 3) and on the stabilisation of their scientific nomenclature has formed the basis of economic investigations by other experts in the Institute.

The identification of diseases of trees and timber caused by fungi, which is the work of the **Mycologist**, has been essential for the progress of research in entomology and wood preservation.

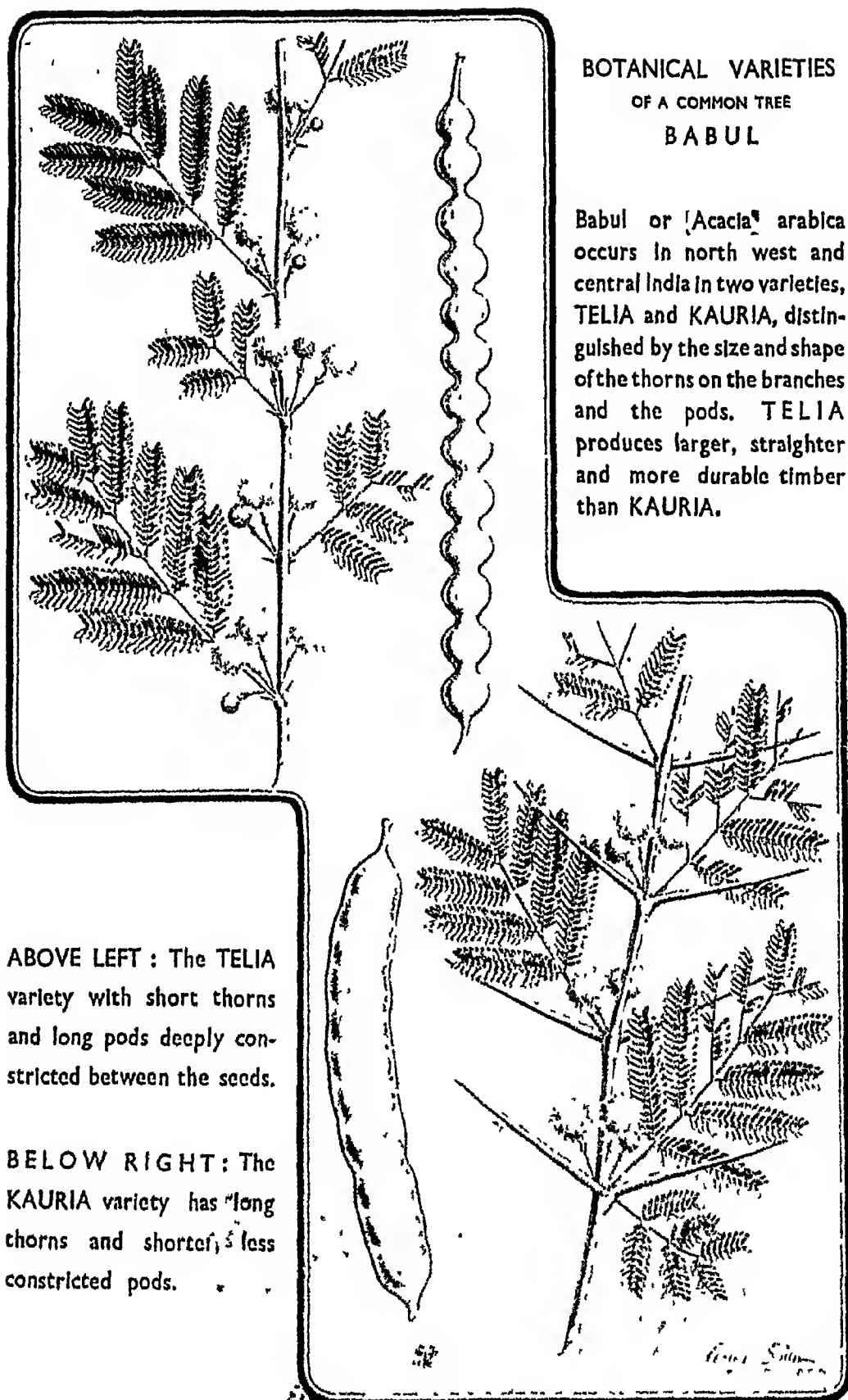
The identification of forest insects and of pests of trees and wood is the work of the **Systematic Entomologist**. His taxonomic studies of the larval stages of wood borers have removed many of the difficulties connected with the discrimination of pests and harmless insects. The **Entomological Collection** has steadily grown and now contains over 15,000 species of insects. Frequent use is made by Agricultural Departments, Universities and Schools of the special

BOTANICAL VARIETIES  
OF A COMMON TREE  
BABUL

Babul or *Acacia arabica* occurs in north west and central India in two varieties, TELIA and KAURIA, distinguished by the size and shape of the thorns on the branches and the pods. TELIA produces larger, straighter and more durable timber than KAURIA.

ABOVE LEFT : The TELIA variety with short thorns and long pods deeply constricted between the seeds.

BELOW RIGHT : The KAURIA variety has long thorns and shorter, less constricted pods.







information it provides. Activity in systematic entomology at Dehra Dun has secured the gratuitous services of a large auxiliary force of specialists in various countries—a practical result of measurable value which has saved government the salaries of specialists who would otherwise have had to be employed in India.

## 2. RESEARCH ON TIMBER AND WOOD USING INDUSTRIES.

### CORRECT IDENTIFICATION OF TIMBERS.

Cheap timbers of poor quality are often put on the market under the names of better class timbers of proved reputation. The superficial appearance of a timber, its colour, grain and other external characteristics, are often deceptive, but by microscopic examination the Wood Technologist can accurately identify a piece of wood. Plate 4 shows the anatomical structure of teak grown under different conditions. Valuable help has been given to government departments such as Railways, Army, Air Force, Irrigation, Industries, Commercial Intelligence, to Port Trusts, Corporations and many business concerns, and this help has prevented costly mistakes arising from wrong identifications as the following examples demonstrate.

#### RESULTS OF REAL VALUE.

The Chief Engineer, E. B. Railway, sent 123 sleeper ends with the remark that these sal and pyinkado Railway sleepers. sleepers had to be taken out of the line after only six years. On examination only 14 out of the 123 were found to be sal or pyinkado which are durable woods. The rest were non-durable cheap timbers.

The E. I. Railway bought 6,000 logs for coach-building but did not know whether the logs were of the species specified. The help of the Wood Technologist was sought and it was found that over 15 per cent. of the logs had been Coach building timber. supplied under false names. The logs were then identified and classified by the Wood Technologist in order that they might be utilised for purposes for which they were suitable.

Both railways now realise the importance of getting the correct species when purchasing timber, and references are now frequently made to the Forest Research Institute asking for help in similar situations.

Several pieces of thitum wood were sent for examination by the Civil Aircraft Inspector, Karachi. Aircraft timber. These were badly attacked with fungus with consequent deterioration of strength. This was reported to

the Inspector and he was supplied with micro-slides to enable him to detect similar defects in the future when purchasing timber or examining aeroplanes for air-worthiness.

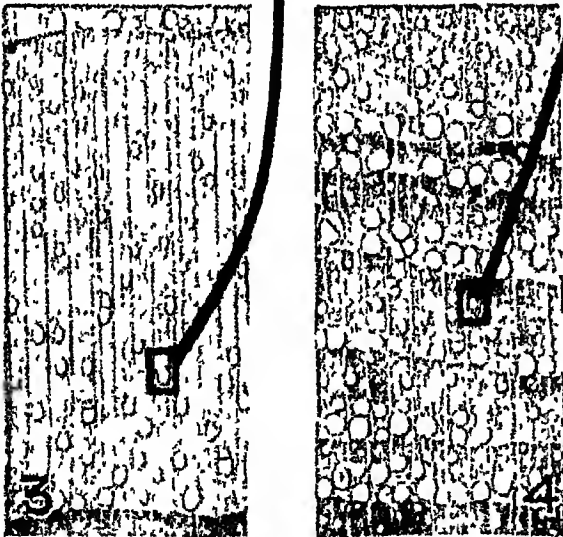
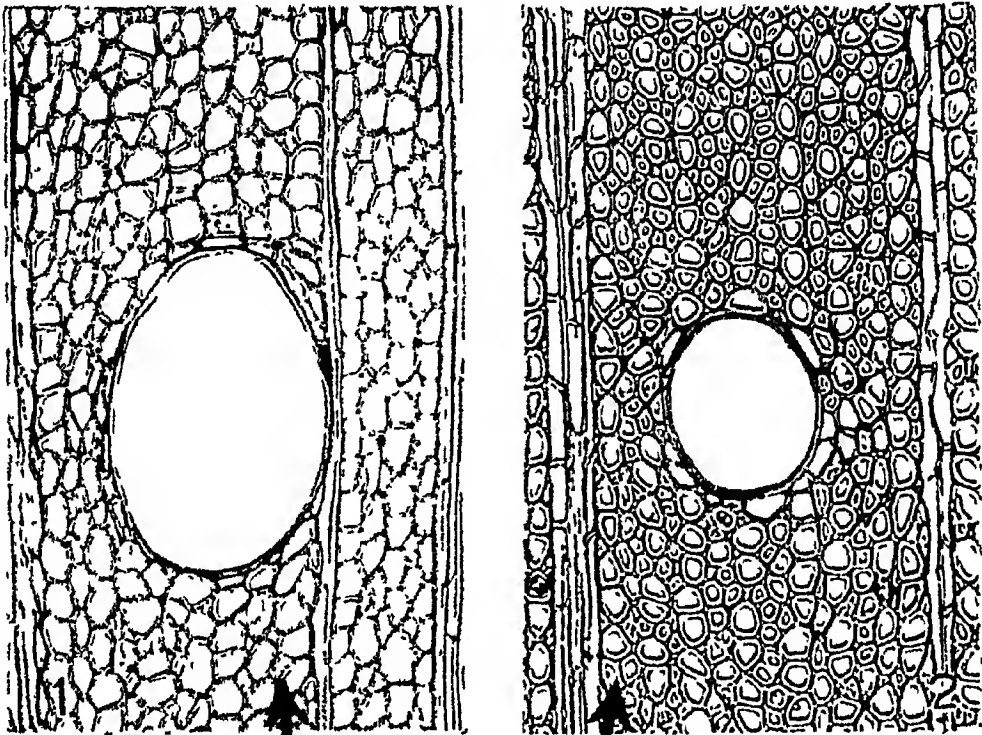
A civil engineering firm in Bombay sought expert opinion on some timber columns and beams which had deteriorated within an unusually short time. The firm wanted a report with a view to finding out the party which had been responsible for the loss incurred. A detailed report was sent pointing out the defects to be looked for when purchasing timber in future. The help given was much appreciated by the firm in question.

The Superintendent, Indian Ordnance Factory, Ishapore,  
 Rifle stock timber. sent several pieces of walnut which had failed for rifle-work. The cause of failure was found to be not anatomical but due to fungal attack. This cleared Indian walnut from being condemned as anatomically unfit for rifle work.

Parts of a broken aeroplane which had crashed at Risalpur  
 Air Force helped. were submitted for examination by the Royal Air Force, for finding out the cause of the calamity. The timber was found to be poor quality Douglas fir and not Sitka spruce as specified by the Royal Air Force. Douglas fir is inferior to Sitka spruce but in general appearance they are alike. Photomicrographs of the two woods were supplied to the Royal Air Force. These will enable the officers concerned to recognise the two timbers with a pocket lens, thereby reducing the risk of further accidents due to the wrong timber being used in aircraft manufacture.

There are in the market many varieties of Indian laurel wood,  
 which is a popular furniture wood in Europe,  
 Figured laurel. and the price obtained for good "figured" laurel is very high. An investigation is being carried out to find the cause of fine "figuring" in laurel with a view to growing trees specially to produce "figured" wood. If this end is achieved there should be a considerable market for "figured" laurel at good prices throughout the world, as it compares very favourably with the finest figured walnut which is used so extensively for furniture and which commands a most attractive price.

Burma teak has always had the reputation of being a very good  
 timber, but recently it was noticed that  
 Varieties of teak. teak from certain localities in Burma was not up to standard. An anatomical study revealed that very fast and very slow grown teak are likely to be unexpectedly weak (Compare Plate 4). This will enable the Burma Forest Department to regulate the rate of growth of teak in future so as to produce the best wood.



## THE STRUCTURE OF TEAK WOOD

Photomicrographs of transverse sections of teak showing in sections 3 and 4, the appearance under a magnification of 5 (i.e. of a hand lens) and in 1 and 2, small portions of the same magnified 200 times.

Piece 2 is from normally grown wood of average working qualities.

Piece 1 is from very fast grown wood of inferior working qualities as is evident from the thinness of the fibre walls.

Photomicrographed by the Wood Technologist.

of plant and in the initial stages of erection and operation. Demonstrations in methods of stacking for air seasoning and in the technical operation of all kinds of kilns are willingly given to any one interested.

#### SOME PRACTICAL RESULTS OF SEASONING RESEARCH.

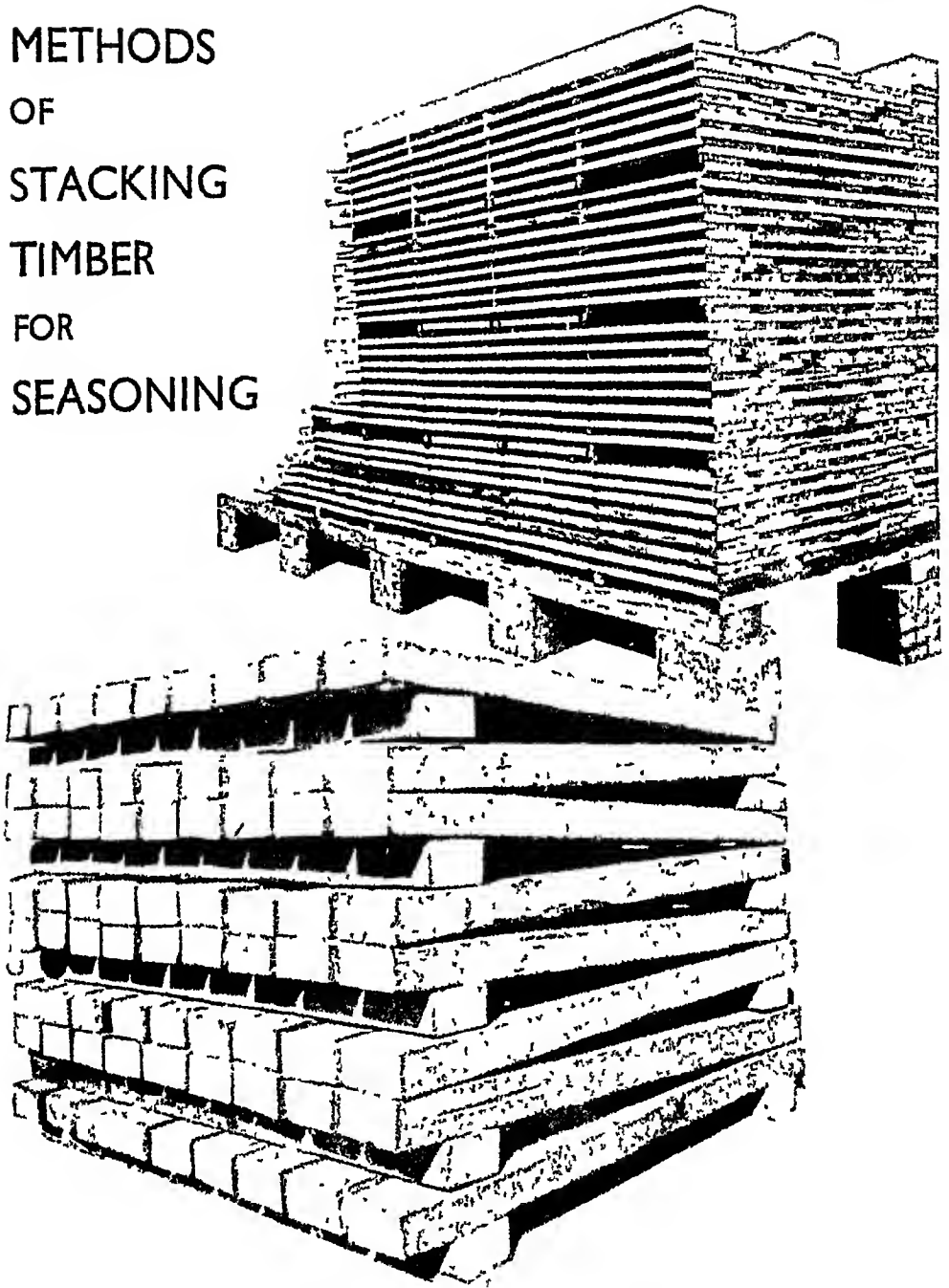
The Gun Carriage Factory at Jubbulpore, on the recommendation of the Forest Research Institute, installed a battery of 10 seasoning kilns in 1927. Kiln-drying proved so satisfactory that the erection of another battery of 10 kilns was taken in hand during 1930. Besides the reduction in degrade of timber, and saving in interest on capital locked up in timber during 4 to 5 years of air-seasoning, the factory experienced one outstanding advantage, namely that the manufacture of gun carriage wheels, which had to be entirely stopped during the rains for about half the year, can now be carried on continuously.

The Ishapore Rifle Factory purchases as much as £90,000 worth of walnut a year. In the past, the loss due to degrade after 4 years' air-seasoning has been about 10 per cent. The degrade on walnut kiln-dried at the Forest Research Institute was practically nil. A battery of 4 seasoning kilns was erected at Ishapore on the advice of the Forest Research Institute. If the Ishapore Rifle Factory keeps up the same standard it should be saving approximately £9,000 a year.

The figures for sleepers rejected by Railway Passing Officers at various depots of the Punjab have been very high for some years past, the average rejections amounting to not less than 50 per cent. of the number of sleepers offered. As a result of various experiments on the seasoning of softwood sleepers carried out by the Forest Research Institute during the last nine years, proper methods of stacking sleepers of various species have been suggested (see Plate 5). A coating of coal tar applied to the ends of sleepers before stacking has also been found to reduce end-splitting considerably. The periods necessary for proper air-seasoning of sleepers have been worked out.

A timber drying-kiln according to a design supplied by the Forest Research Institute was recently erected by the Gramophone Co., Ltd., at Dum Dum, Calcutta, for kiln-seasoning indigenous woods for the manufacture of gramophone and wireless cabinets. This has already resulted in an increased use of Indian timbers, in place of imported foreign timbers which were the main source of supply before. In fact it seems that Indian woods will shortly replace entirely the imported woods formerly used for this purpose.

METHODS  
OF  
STACKING  
TIMBER  
FOR  
SEASONING



ABOVE : A well built stack of timber for air-seasoning. The vertical alignment of crossers prevents warping and twisting.

BELOW : Railway sleepers stacked for air-seasoning by the 1 and 9 method to ensure rapid drying. Other methods are used for refractory timbers in very dry climates.



There is a considerable demand for hollock and hollong floor boards in Great Britain, provided the material is shipped in a properly dried condition. The Assam Railway and Trading Co. have put up a kiln at Margherita according to a design supplied by the Institute, and now find they have a good export market for these kiln-seasoned floor boards.

A battery of two kilns installed by Mansfield and Sons at Calcutta was designed at the Forest Research Institute. It was built primarily to kiln-dry indigenous hardwoods for Government House at Darjeeling, and will subsequently be used as a commercial installation for kiln-drying formerly little used Indian woods for the market in Calcutta and elsewhere.

On the advice of the Institute a battery of two kilns has recently been erected by Curzon and Co., at Madras, for kiln-drying timber for their own furniture manufacture, and for selling to other furniture manufacturers. This will stimulate interest in Indian furniture woods to the advantage of the Forest Department. Such timbers have been sadly neglected in the past owing to the difficulties of seasoning, but a remedy has been devised by the Seasoning Section at the Forest Research Institute. The remarks of this firm reflect the growing realisation in the trade of the value of proper seasoning :—

"The installation of this seasoning kiln enables the utilization of species of timbers which will otherwise be unfit for fabrication. Many species will now be brought into popular use on account of kiln-seasoning."

## WOOD PRESERVATION.

Commercial wood preservation is a powerful industry in all civilised countries and its encouragement in India has been and can still be materially assisted by the research work done at Dehra Dun. The Wood Preservation Section is destined to play an important part in the extensive and scientific use of treated timber for engineering structures in place of steel and concrete, which have recently made serious inroads into the structural field formerly occupied by untreated wood. Extensive timber utilisation in a tropical country, where white ants and fungi abound, should be synonymous with cheap and efficient preservation.

### HELP TO RAILWAYS.

As a result of the new specification evolved for the preservative treatment of coniferous sleepers (based on a new principle of fluid impregnation into porous bodies) the Railway Department is now saving about 3 lakhs of rupees a year over their previous expenditure on sleeper treatment. A pointed reference to this



work, including the saving, was made by Sir Girja Shanker Bajpai in the Legislative Assembly during the budget session of March 1931.

As a direct outcome of the same research the Railway Board revised the former specification for chir and blue pine sleepers omitting all restrictions imposed previously on the content and distribution of sapwood in such sleepers. According to the Chief Conservator of Forests, United Provinces, this deletion of previous restrictions has not only made available 50 per cent. more sleepers from the same volume of trees as cut before, but has placed the chir sleeper in a position to compete with the low-priced metal sleeper and to hold its ground in the sleeper market.

#### A VALUABLE DISCOVERY.

A new preservative which appears to be superior to other known antiseptics for the preservation of wood has been evolved by the Officer-in-charge of the Wood Preservation Section. The claims put forward for this preservative were investigated by a special committee appointed by the Railway Board. A very favourable report on it was published. The Committee recommended the immediate treatment of 1,50,000 sleepers with this new medium, the permanence and wood-preserving efficiency of which was accepted *in toto*. This preservative, which is known as Ascu, should be of great value to the Forest Department and others, as it will enable them to exploit hitherto perishable woods for many purposes. Such woods can now be made to have the same durability as teak and sal.

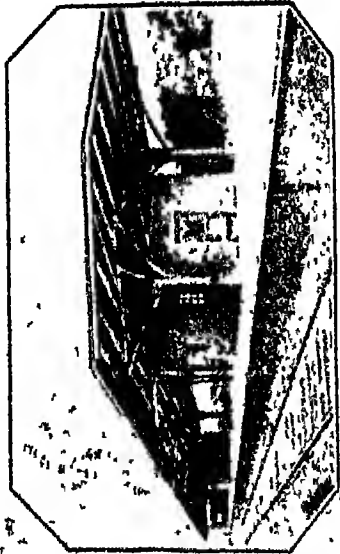
#### GOVERNMENTS ADOPT THE NEW PRESERVATIVE.

The services of the Wood Preservation expert were secured by the Governments of Madras and Mysore and Travancore. State to advise the various Heads of Departments of the two Governments on matters relating to a more extensive use of indigenous timbers. As a result of this deputation the Government of Madras has put up two pressure treating plants which have resulted in an increased use of previously little used woods. Both Governments are now using on a large scale the new preservative for treating electrical poles, sleepers, building timbers, etc.

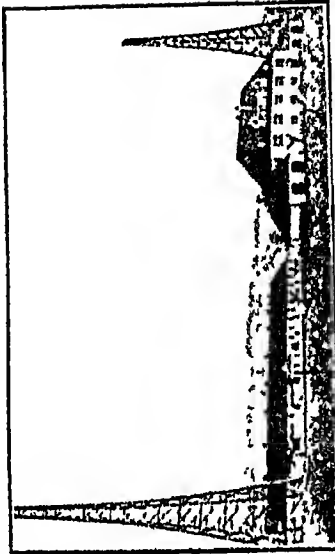
#### INDIAN STATE EXPERTS TO SAVE LAKHS OF RUPEES.

The Government of Travancore also asked for the services of this expert to prepare a comprehensive scheme for the economic and scientific utilisation of the State's timber resources. Most of the recommendations were accepted and a large wood-preservation plant was recently erected. The State is treating locally produced wood poles for high voltage transmission, distribution, and service lines, besides installing a telephonic line of 200 miles. As a result

**TREATED WOOD**  
IDEAL FOR  
ELECTRIC POLES AND ROOF STRUSSES.



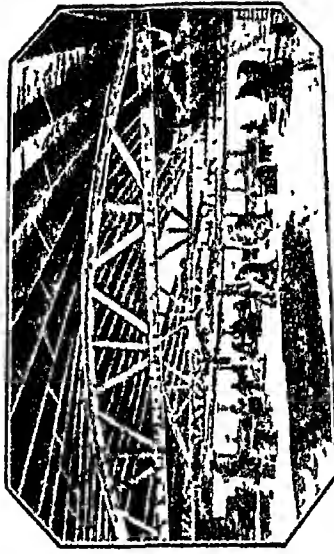
Treated wood railway  
platform shed.



Treated wood towers for  
wireless transmission.



Treated wood poles for  
high tension lines.



Treated wood roof  
for halls and workshops.



of the use of treated wood poles, the State expects to save a sum of six to seven lakhs of rupees within the next five years.

The expert on wood preservation also made a comprehensive scheme for the utilisation of the timber resources of Bhopal. A direct result of this deputation will be seen in the near future in the erection of a high voltage transmission line, besides a 300 miles' telephone line, carried over treated wood poles, in place of the usual imported metal poles.

On account of the excellent results that have been obtained with the new preservative in the various major harbours of India, the Cochin harbour authorities have decided to put up an Ascu pressure plant, while the Port Trusts of Madras, Bombay and Vizagapatam are now considering the installation of pressure plants for preserving all their timber requirements against marine organisms.

#### HYDRO-ELECTRIC SCHEMES.

The Hydro-electric Department of the Government of the United Provinces has recently put up a high tension line of 400 miles of Ascu-treated wood poles. They are now taking steps to get wood poles for the installation of another 400 miles' of high tension line. Over 12,000 poles have been or are being purchased for this purpose from the forests of the United Provinces. In addition to a saving of about two lakhs of rupees for the Hydro-electric Department, a new and lucrative field for wood poles from Indian forests has been definitely created and promoted as a direct result of the invention of Ascu.

The Hydro-electric Departments of the Governments of the Punjab and the North-Western Frontier Province have also been given considerable advice on the subject of wood poles for electric transmission. Both Governments have accepted Ascu for preserving wood poles in their high tension lines.

The Lahore Electric Supply Co., which manages about a dozen electric supply corporations, have also decided to use treated wood poles in place of metal poles, and their annual requirements are estimated to be about 3,000 poles.

The Simla and Murree Electric Supply Corporations last year used several hundred Ascu treated softwood poles and cross-arms, in place of the usual metal poles.

#### EIGHT NEW TREATING PLANTS THIS YEAR.

Finally, Messrs. Callender's Cable and Construction Company, one of the largest electrical contracting firms in the world, are

shortly putting up 8 Ascu treating plants (besides the two they have already) for the supply of treated indigenous woods for various public utilities in the country.

It is scarcely necessary to emphasise that the invention of Ascu has now made it possible for indigenous timbers to compete with steel, iron and concrete for structural purposes, so that a new industry of considerable importance is coming into being. This will not only increase the revenues of the Forest Department from sources which gave a poor income before, but will lead to the employment, directly and indirectly, of thousands of educated men, artisans and manual workers, and will reduce imports of foreign materials.

#### NEW TIMBER PROPAGANDA BUREAU

As a direct result of the work that has been done in the Forest Research Institute during the last few years a Timber Development Section has been opened which will systematically promote the use of timber for structural purposes in this country. This new Section will undoubtedly be of considerable benefit to the Forest Department, other Government Departments and the timber trade generally, and will help to keep the timber resources of India, one of the most valuable assets of the country, before the eyes of architects, structural designers and engineers generally.

#### WORMINESS, BORERS AND DRYROT OF TIMBER.

Efficient protection against borers and white ants can usually be assured for manufactured timber by treating it with preservatives. For conditions where these are unsuitable, special remedies based on studies of the habits of the insects have been devised by the Forest Entomologist. (Plate 6 illustrates cages used for studying wood borers in the insectary).

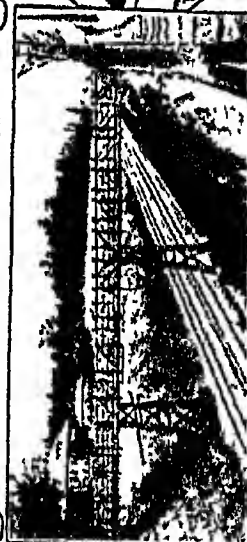
In sawmills and factories damage due to pests is aggravated by incorrect methods of management, *e.g.*, seasoning of the raw material and the finished product, grading of quality, conditions under which stocks are held and sold, disposal of waste, etc. Advice on their particular problems has been given to many companies in the furniture and lumber trade, the packing-box, match and plywood industries, either by personal visits of the entomological staff or by special experiments at Dehra Dun. The remedies devised are cheap and effective, and have enabled manufacturers to guarantee the issue of clean borer-free material and have reduced their losses from rejections.

Investigation of the distribution of dry wood borers in sea-ports and in the dunnage of ships' holds has done much to improve the reputation of Indian timbers in foreign markets and to remove misconceptions as to their liability to damage by indigenous and

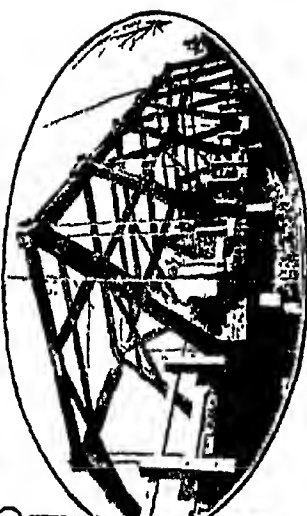
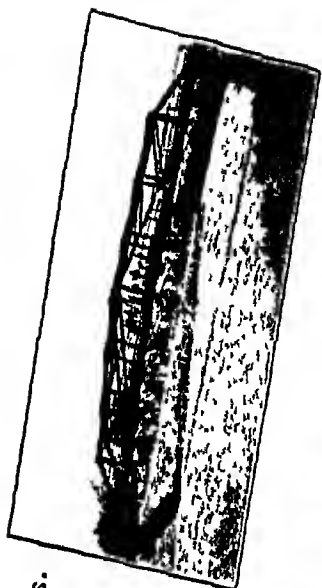
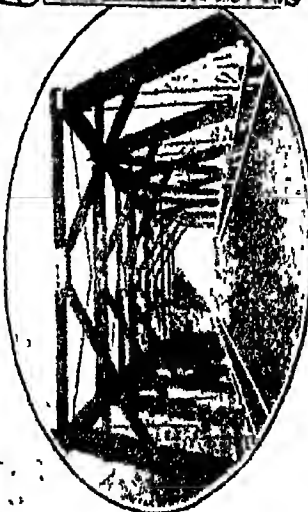
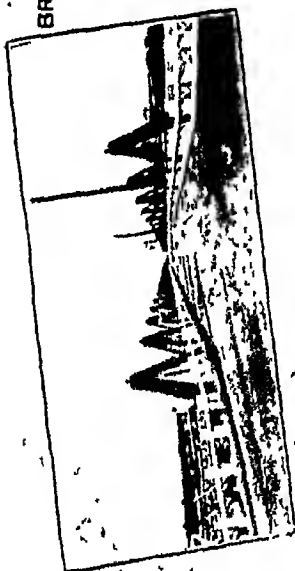
TREATED TIMBERS  
IDEAL FOR  
BRIDGES, RAILWAYS AND HIGHWAYS.



A Treated Junglewood  
Railway Trestle Sound  
After 25 Years' Service  
Under Tropical Conditions.



Treated Timber  
Has Been Used in  
Bridge Construction  
For Two Centuries.





cosmopolitan pests. The independent position of the Forest Research Institute enabled it to settle controversial matters involving the millers, shippers and importers, and to ensure that at each stage in the handling of timber for foreign markets it is protected against insect attacks.

#### PEST CONTROL FOR THE ARMY AND RAILWAYS.

Other successful entomological investigations have provided specifications for the Army Stores and  
Tapis and lance staves. Clothing Department; and buying and storage specifications for bamboo lance staves and telephone and tent poles for the Ordnance Department. The measures for the protection of bamboos were designed to reduce the purchase price at which contractors can supply staves, and to eliminate the rejections of staves and poles in service and in store.

Railway workshops and military arsenals have also benefitted from improvements in methods of purchasing and storing their timber supplies, which have reduced their troubles from wood borers.

Advice on rots due to fungi in railway sleepers, scantlings and wood in buildings has been given by the Mycologist.

#### REMEDIES FOR WHITE ANTS.

White ants or termites are a source of trouble to nursery gardeners, fruit growers and to every owner of a building, and seriously affect the constructions of the Public Works, Military Works and Railway Departments. A pamphlet has been published dealing with the control of these pests under all ordinary conditions and the Entomologist has given advice in individual cases whenever it has been requested. But it must be admitted that the Forest Research Institute has not been as successful as it could be in impressing on

the general public the fact that the white-  
White-ant-proof buildings. ant-proof buildings can be erected in India, and that it is unnecessary to submit year after year to the damage caused by white ants which have invaded an improperly constructed building. There is valuable information at Dehra Dun which should be utilised by architects and engineers, both departmental and commercial, and should be incorporated in inadequate municipal by-laws and building codes.

Marine borers. and measures have been devised to prevent  
waters. damage to logs while floating in estuarine waters.

#### STRENGTH TESTS ON INDIAN WOODS

Between 300 and 400 species of Indian trees produce good woods but only a fraction of these are well-known and extensively used.



Many species that produce excellent timbers are used for fuel in ignorance of their qualities, and there are others that are entirely neglected although possessing special properties suitable for a variety of purposes.

The chief aims of the Timber Testing Section are (1) to determine the mechanical and physical properties of Indian woods and thereby to find suitable outlets for those of which the supply is in excess of the demand, (2) to find Indian substitutes for imported timbers used for a variety of special articles, and (3) to advise enquirers as to the suitability of timbers for all purposes where strength is an important factor.

#### 150 WOODS TESTED ALREADY.

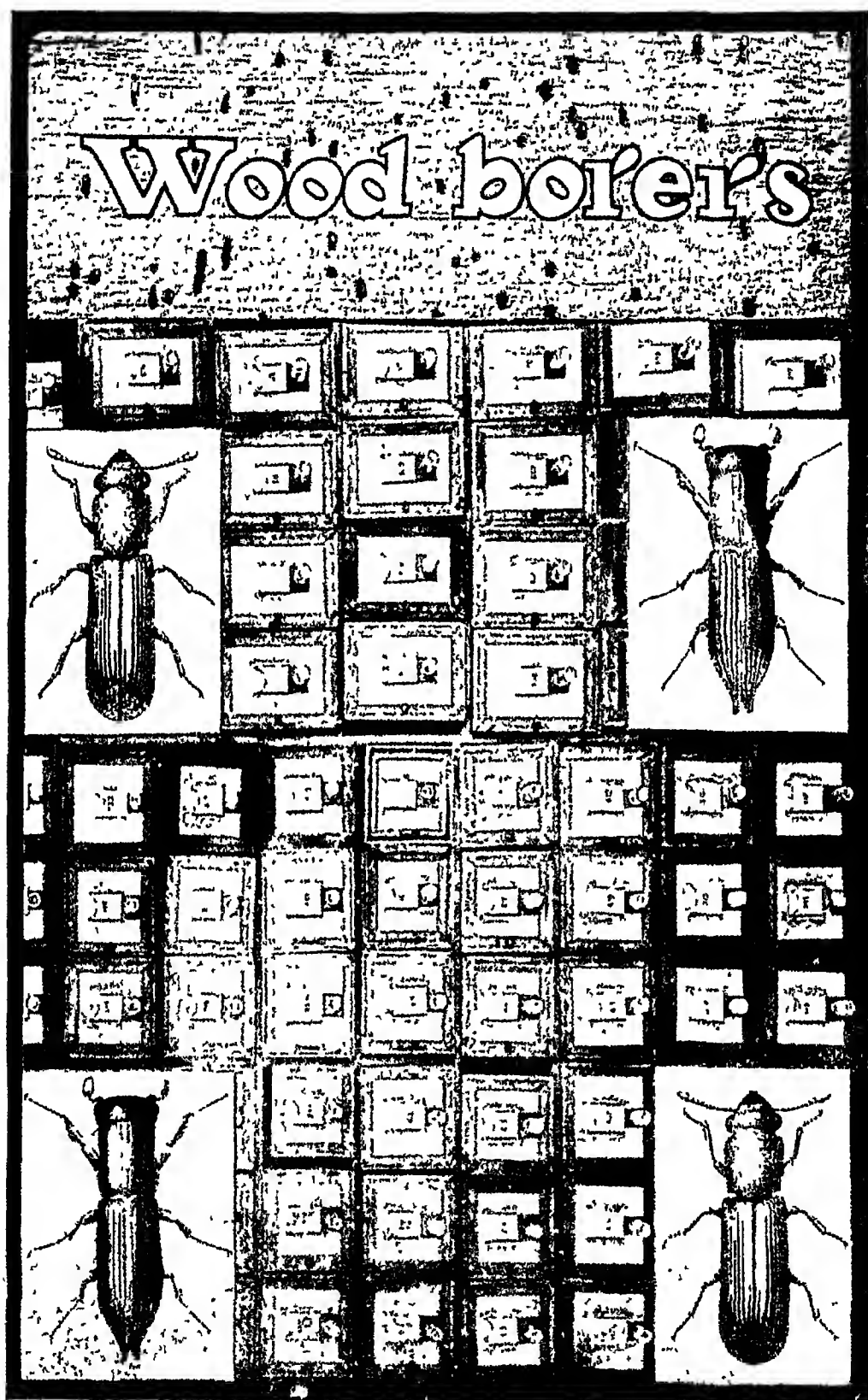
The Section can now give advice on about 150 Indian species and is working actively on many more. It is equipped with mechanically operated timber-testing machines capable of providing data according to modern standards. Plate 7 shows the Timber Testing Laboratory. Several booklets on strength data and working stresses have been published to enable engineers to use available timber without any doubt as to its performance.

In conjunction with the Wood Technologist, who studies the finer structure of wood, scientific strength testing has led to the discovery among Indian timbers of several good substitutes for imported woods used in many industries. Tool handles, picker-arms, bobbins, shuttles, sports goods, plywood, etc., which are at present either imported or made from imported timber can be manufactured equally successfully from indigenous species.

#### RESEARCH CREATES HUGE DEMAND.

For example, tests were made to find out what Indian woods were suitable for making tool handles for Indian Railways. The woods recommended by the Forest Research Institute were accepted by the Railway Department and are now included in their tender specifications. In consequence the Burma Forest Department has built up a big trade in handles made of yon wood, a species which was not in any demand formerly. Last year the demand for yon tool handles was so great that the Burma workshops were unable to make all that were required, and steps have been taken to organise the manufacture of tool handles from yon wood in Calcutta. This is an instance of a new industry that has actually sprung up as the result of timber research at Dehra Dur.

Grading rules for teak squares were recently prepared and published after making a thorough study of the milling operations in Burma saw-mills. 1,87,000 cubic ft. of timber was examined for this purpose, and an



Cages used in the INSECTARY of the Forest Entomologist for the study of insects damaging timber. Inset are beetles of *Platypus solidus*, a pinhole-borer of green timber, and *Lyctus africanus*, a powder-post-borer of seasoned timber. The background to the title is pinholed wood, natural size.



enormous amount of computation work was done in order to compile suitable rules. The grading rules will standardise teak in Indian markets, and buyers will be able to select at a distance the right class of teak timber for every need, with the additional security that they will receive exactly what they order. The grading rules will also help Indian and Burma teak to compete on better terms with teak from Siam and Java. The Conservator of Forests of the Utilization Circle, Burma, considers that this study of teak grading is likely to have far reaching and wide consequences for the future benefit of the timber industry of that province.

#### GLUE TESTS FOR AIRCRAFT ENGINEERS.

All glue joints submitted by civil aircraft ground engineers for their licence examination are now tested at the Forest Research Institute. The quality of the work submitted by these ground engineers has shown a very substantial improvement since the Timber Testing Laboratory undertook these glue tests for the Inspector of Civil Aircraft. This has had the effect of making the repair work of aircraft more dependable and flying safer. Strength tests are also done for the Civil Aviation Directorate on aeroplane parts broken in accidents in order to determine the quality of the wood used or the cause of failure. This work is much appreciated by the Civil Aviation authorities.

#### INDIAN WOODS FOR SPORTS GOODS.

Tests on mulberry wood from Punjab irrigated plantations showed that this species was better than imported ash for sports goods and especially for hockey sticks. The demand for Indian mulberry has developed so much lately that the Chamber of Commerce had recently to request the Punjab Government to increase the extent of mulberry plantations.

Recently the timber section of the Military Works Handbook *Help for military works.* was re-written by the Timber Testing expert at Dehra Dun. This has enabled the Military Department to supply correct and up-to-date information to their Engineering and Military Works units on Indian woods, their comparative strengths, and the best woods to use for a given purpose.

It will be seen, therefore, that the Timber Testing Section is in a position to offer considerable help to those interested in uses and markets for the less known Indian woods. Those who desire advice on more specialised industries, such as the manufacture of plywood or matches, will find other experts at the Research Institute able to supply the fullest practical information.

#### VENEERS AND PLYWOOD.

Within the last few decades veneers and plywood have been accepted throughout the world as extremely important commercial

products and they are now taking a place in the timber markets of the world which bids fair to rival that of any other timber product. The world consumption of plywood is approximately 1,500,000 tons annually, of which India imports and consumes over 36,000 tons. There are two plywood mills in India (both assisted by the advice of the Institute) but they contribute only a very small portion of the tea-boxes required to meet India's demand for packing-boxes, which are imported to the tune of over 8,000,000 a year.

It was entirely with the object of utilizing India's natural resources and of assisting a young industry to compete with the enormous imports of foreign plywood that intensive research on veneers and plywood was inaugurated in the Wood Workshop Section, which is fitted out with an experimental quasi-commercial rotary veneer-cutting plant. (See Plate 8). Over sixty Indian timbers have already been tested to ascertain their suitability for utilitarian and decorative veneers and plywood, and much research has been done on glues.

#### FURNITURE AND PANELLING.

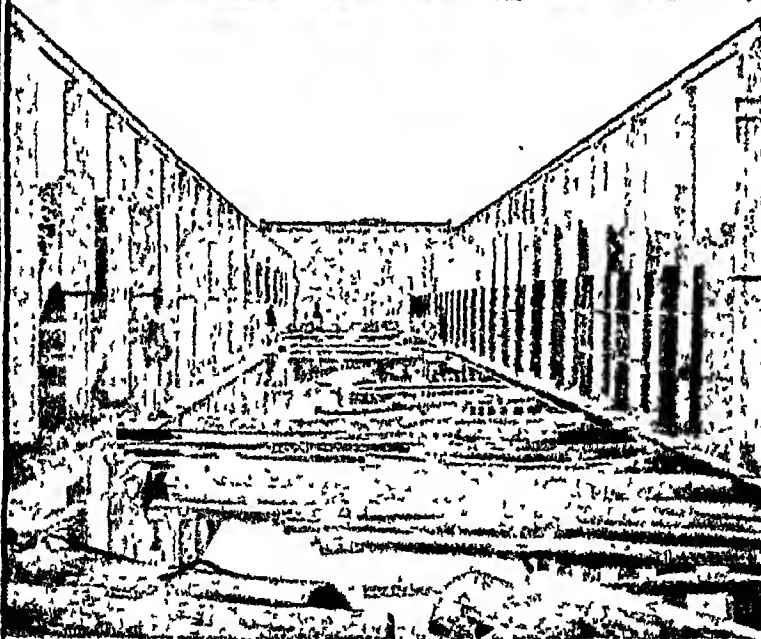
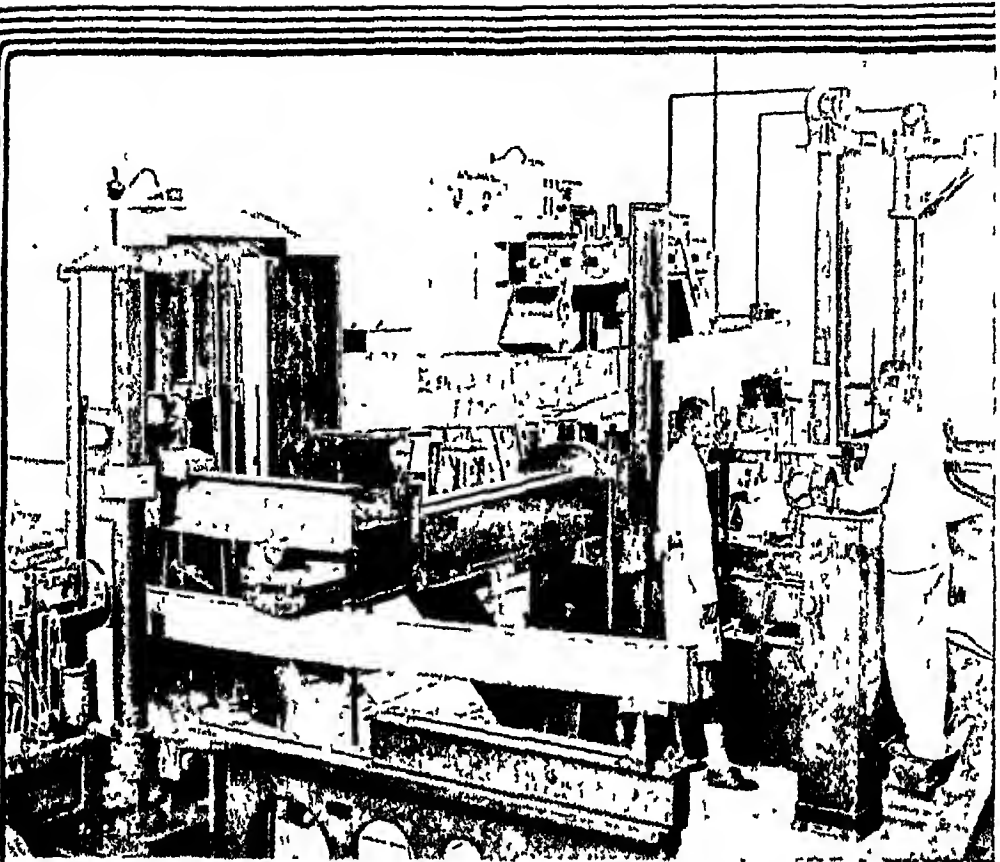
The Wood Workshop Section has a working plant of saw-mill machinery run on modern commercial lines, and an electrically driven plant of wood-working machines. Tests are made of the working qualities of all important Indian timbers. In these workshops beautiful examples of furniture, cabinet-work, parquet flooring and panelling are constructed and are displayed in the Institute's museums, offices, library and boardroom (see Plate 1, Frontispiece). These examples should convince those in the industry of the tremendous possibilities for Indian timbers, and should arouse a desire on the part of Indian citizens for aesthetically furnished homes.

The practical help and technical advice of the Officer-in-charge of Wood Workshops are available to all on any subject relating to the utilization of Indian timbers, sawmill construction and management, wood-workshop management (manual and machine) from designing and drafting to the finished product, and also on adhesives and veneer and plywood problems.

He was, for example, responsible for the panelling of the whole of the Legislative Assembly building at New Delhi in timbers other than teak. Letters of congratulation and appreciation were received for the work done there.

#### PLYWOOD FACTORIES.

Technical advice given during a visit of the wood-working expert to the plywood mill of the Assam Sawmills and Timber Co. at Murkong Selek, and the tests of their plywoods carried out in the



ABOVE:  
THE  
TIMBER  
TESTING  
LABORATORY

BELOW: THE LOG POND  
EQUIPMENT IN THE ECONOMIC BRANCH



Section enabled them to correct their manufacturing methods and to produce a far better quality of plywood and a greater output than formerly. The Company found it worth while sending their Manager to study the manufacture of plywood at the Forest Research Institute.

The Assam Railways and Trading Co. also made use of the services of the Officer-in-charge of Wood Workshops and the measures recommended by him were immediately productive when adopted in their plywood mill at Margherita. The Manager expressed the opinion :—

“that the assistance given was of immense value to them and that you did more good for the company in two days than others had done in four years. It is to your credit that the company has been saved endless futile expenditure. We feel very thankful and appreciative indeed.”

Measures for the control of insect pests of the woods used by both mills have been devised, which remove one serious reproach against Indian plywood by permitting sales under a guarantee of immunity from borers and also allowing stocks to be held for long periods without anxiety.

#### HELP GIVEN TO ARMY ENGINEERS.

Owing to the bottom skids of army collapsible boats invariably breaking when the boats are folded, the Officer Commanding the Sappers and Miners at Roorkee sent one of these boats to the Forest Research Institute for examination. It was found that it was the design of the boat and not the wood which was at fault, and by a simple alteration in the design, the difficulty was overcome, and the boats are now completely satisfactory.

### 3. RESEARCH ON FOREST PRODUCE OTHER THAN TIMBER.

Numerous minor industries are concerned with the great variety of forest produce other than timber, e.g., sandalwood oil, cutch and katha ; rosha oil, lemon-grass oil, camphor, charcoal, rosin and turpentine and other distillation products ; tans, dyes, drugs, spices, fibres, flosses and edible products. The Minor Forest Products Section collects information on these commodities and provides forest contractors, chemical works, drugs exporters and merchants with up-to-date information as to the localities in which they are abundantly found, their constituents, uses and commercial demand. Over 250 such enquiries were dealt with in 1934 and 300 in 1935. In the aggregate the Research Institute has done much useful work for the small trader although no one of the results is particularly spectacular.



## WOODS FOR MATCHES.

A list of Indian woods tested for match manufacture has been published incorporating the results of trials made at the Forest Research Institute and in Indian match factories. The list will be of great use to the Indian match industry not only as regards present supplies of woods for match work, but also for starting plantations of suitable species.

## A PORTABLE CHARCOAL KILN.

A portable charcoal kiln (known as the "Frikiln") was devised and made at the Forest Research Institute. Replicas of this kiln are now used in two Indian States. The Forest Departments of the United Provinces, Bihar, Madras, Bombay, Central Provinces, North-West Frontier Province, Mysore and Bhopal and several charcoal contractors have recently been supplied with scale drawings of the kiln with a view to manufacturing similar kilns for use in their forests. Firms engaged in making coconut shell charcoal for gas masks are also interested in this kiln, which has several advantages over the type of kiln formerly used for charcoal making.

## CHEMICAL RESEARCH.

The chemical research, which is necessary for the isolation of pure products and is the background for industrial and applied research is undertaken by the Biochemist. His work on marketable products from the raw materials of forest origin, such as fixed oils, fats, essential oils, gums, resins and drugs, has in many cases brought about their commercial exploitation.

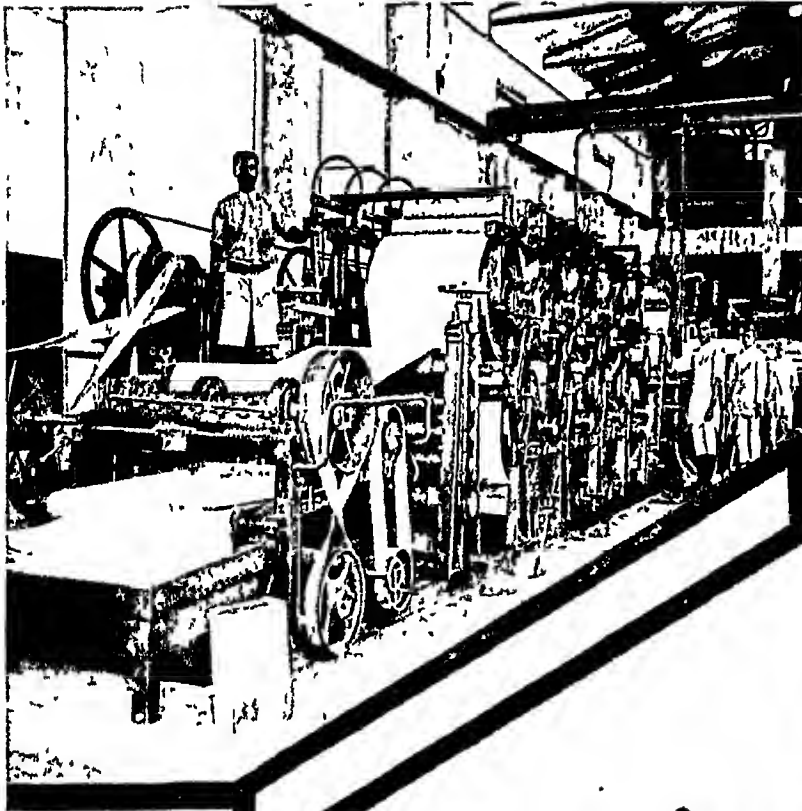
## PROMOTION OF TURPENTINE AND CUTOH MANUFACTURE.

The establishment of the turpentine industry in India owes much to the pioneering work done in the laboratories of the Forest Research Institute.

The oil produced from chir wood in the early days of the industry had certain defects (stickiness and slow drying), which gave it an inferior position in the trade. Modifications of the distillation process were devised which have enabled factories to produce Indian turpentine that to-day compares very favourably with the best American and French grades.

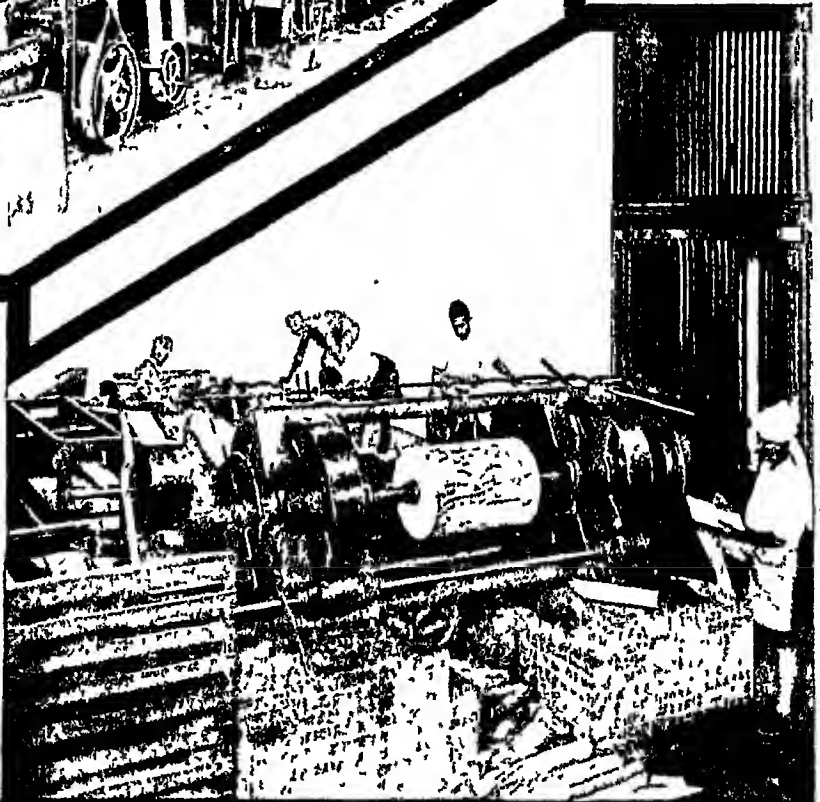
Experimental work on the manufacture of katha and outch from khair wood resulted in the establishment of a factory in the United Provinces, and promoted the utilization of *Acacia sundra* for these products in south India.

Improvements in the "country" method of making katha, which were devised at the Forest Research Institute have produced not only better katha but also cutch equal in value and quality to the best Burma cutch, under the "country" method cutch was allowed to go to waste.



PAPER  
MAKING  
PLANT

ROTARY  
VENEER  
PEELING  
LATHE



ABOVE : A semi-commercial pulp and paper making plant in the  
PAPER PULP SECTION.

BELOW : A Veneer Lathe in the WOOD WORKSHOPS.  
EQUIPMENT IN THE ECONOMIC BRANCH



The presence in India of *Artemisia*, a plant which yields santonine, was doubted a few years ago, but systematic search discovered commercially valuable species in the north-west. As a result a factory for the extraction of santonine is established in Kashmir, while the Political Agency, Kurram, obtains considerable revenue from the export of *Artemisia* to Europe.

#### INDIGENOUS DRUGS.

Studies of the chemistry and pharmacology of indigenous drugs in collaboration with medical investigators has placed in the hands of doctors and pharmacologists new and more reliable remedies.

When it was discovered that the alkaloids in the plant, *Ephedra*, are constitutionally similar to adrenaline, Ephedrine and Vasicine, a valuable animal product, ephedrine-bearing species were sought for in India and found to be richer in ephedrine content than the Chinese species, that at one time met the entire demand for this drug. India and Baluchistan now export large quantities of ephedra.

A study of the alkaloid, vasicine, isolated from the weed, *Adhatoda vasica*, and the determination of its therapeutic properties has led to the wide use of this drug by medical practitioners and its manufacture by pharmaceutical firms in India.

#### OIL SEEDS AND INSECTICIDES.

Investigations of the numerous oil-bearing seeds of forest plants have indicated their commercial importance in candle and soap manufacture, for sizing purposes, and as intermediates in the manufacture of a newer type of detergent. Arising from an examination of insecticides and fish-poisons made from vegetable products it has been found that derris roots sufficiently rich in rotenone (the insecticidal principle) and commercially exploitable occur in India.

#### PAPER PULP.

The investigations on bamboo carried out at the Forest Research Institute have helped the Indian paper industry, with the aid of protection, to capture gradually the market of imported writing and printing papers to the extent of about 12,000 tons and the value of about 50 lakhs of rupees per annum. In 1924-25 the consumption of bamboos in Indian paper mills was about 4,600 tons. In 1935 it was over 30,000 tons (the consumption of sabai grass remaining practically constant).

Extensive existing paper mills are now in progress for a further increase in the use of Indian bamboos, and it is hoped that in the near future the present imports of foreign wood-pulp to the

extent of about 18,000 tons per annum (of a value of over Rs. 25 lakhs) will be very considerably reduced. The resulting increase in the consumption of bamboos is expected to be in the neighbourhood of at least another 30,000 tons per annum.

During the last four years five additional species of bamboos have been investigated at the Forest Research Institute to enable the paper mills in Bengal to have enough raw material for their growing requirements. The extended use of bamboos by the paper industry not only utilizes the hitherto unexploited forest resources of the country and augments the revenues of Government in several directions, but also helps to develop an important national industry which should grow still larger and more rapidly in the near future as a result of the spread of education among the masses, the rise in the general standard of living and the development of industries and commerce generally.

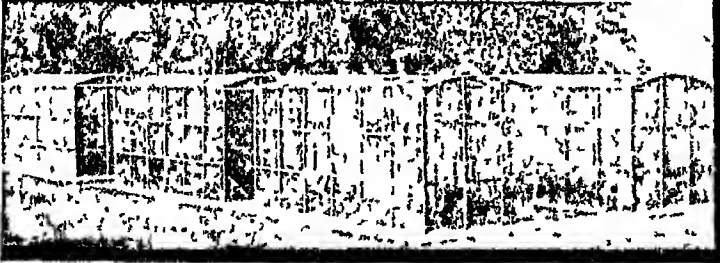
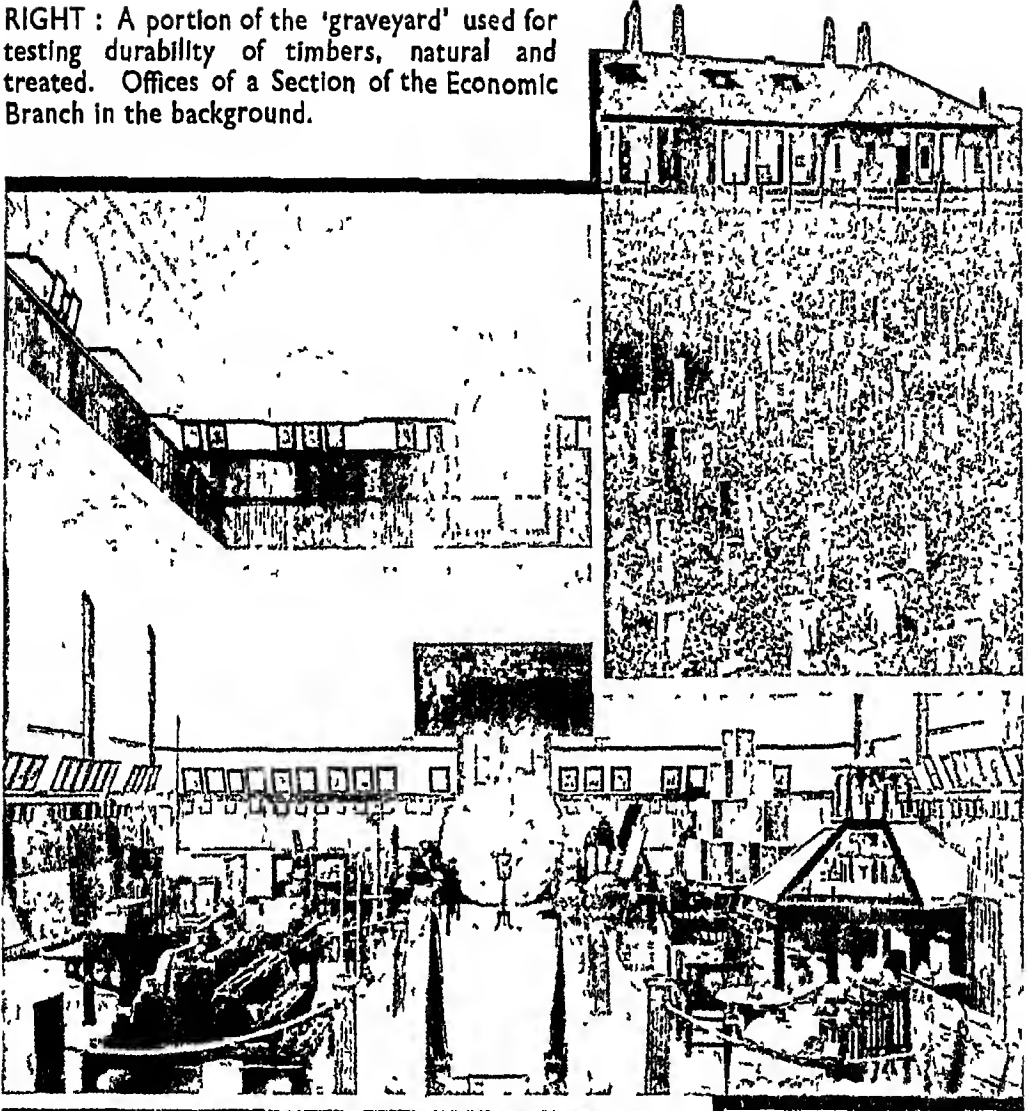
#### HELP FOR PULP AND PAPER INDUSTRY.

A number of problems and difficulties, inherent in the use of a new raw material on a large scale, have naturally cropped up in the case of bamboos. Training apprentices. The Forest Research Institute has undertaken to solve a number of these problems on behalf of the pulp and paper industry and is at present engaged on them. The semi-commercial pulp paper machine operated by the Section is illustrated in plate 8. Further, in order to enable Indian paper mills to increase their efficiency, the Institute has also arranged to give periodically short courses of training to mill chemists and apprentices. A most successful course was held last year and was much appreciated by the Managing Agents of the mills concerned.

Technical advice has also been given from time to time to some of the smaller mills such as the Upper India Couper Mills at Lucknow and the Andhra Paper Mills at Rajahmundry, in order to improve the efficiency of these mills so as to enable them to increase their output of paper and improve its quality. For the establishment of a paper mill in Hyderabad State also, the bamboo supplies of the State were fully investigated at the Forest Research Institute, and one of the State chemists made use of the Paper Pulp Section's laboratories during the investigation.

In recognition of the co-operation and help offered to the industry by the Forest Research Institute the Paper Industry's contribution to research. The Paper Association have agreed to contribute annually to the fund of the Institute. The sum has been further supplemented by gifts from other firms which are not members of the Association. This gesture on

RIGHT : A portion of the 'graveyard' used for testing durability of timbers, natural and treated. Offices of a Section of the Economic Branch in the background.



ABOVE :

One of the six museums.  
The TIMBER MUSEUM  
maintained by the Forest  
Economist.

ABOVE : Cages for the study of the life-histories of forest insects  
in the INSECTARY of the Forest Entomologist.



the part of the paper mills is in itself sufficient to show that the work of the Institute is appreciated and is of commercial value to the pulp and paper industry.

#### HUGE DEMAND FOR CHEAP PAPERS.

The investigations on bamboos have hitherto been confined to their utilization for the manufacture of the better grades of writing and printing papers. The Forest Research Institute is now turning its attention towards the utilization of bamboos for the production of the cheaper varieties of papers such as news-prints, packing and wrapping papers, and boards of various kinds, none of which are at present manufactured in this country. These products constitute more than 80 per cent. of the total imports and about 64 per cent. of the total yearly consumption of paper and boards, and the value of the annual imports is about two crores of rupees. It is, therefore, important that India should be able to produce most of these products and be independent of a large proportion of the foreign imports. The equipment necessary for conducting the experiments is expected to arrive towards the end of the year.

#### SAVING OF RS. 3 LAKHS A YEAR.

In addition to bamboos, grasses and other raw materials also have a place in the programme of the Paper Pulp Section. The application of the "Fractional process," developed at the Forest Research Institute, to sabai grass, which has been used by the Indian Paper Mills for the last 45 years, has effected substantial savings in the use of chemicals. On an average annual consumption of about 25,000 tons of sabai grass this new process represents a saving of about 3 lakhs of rupees per annum.

A process has also been developed for the use of ulla grass, which grows plentifully in the United Provinces and for which no use has been found so far. The extended use of grasses, and other materials like flax waste and bagasse (crushed sugar-cane) which have also been tested at the Dehra Dun Institute, is important for the growth of the paper industry in provinces like the United Provinces, the Punjab, Sind and the Central Provinces, where bamboo is not readily available at cheap prices.

#### ARTIFICIAL SILK.

Another interesting line of work is that referring to experiments in progress at the Forest Research Institute to purify bamboo for use in the production of "fibro," a staple fibre like the "rayon" produced from wood pulp. Encouraging results have been obtained



so far and it is hoped, should funds be available, to obtain a small experimental plant for the production of "fibro" from bamboo and grass pulps. Of late, "fibro" has

Future of fibro. become a keen competitor with long-staple cotton and wool, and may alter the complexion of the textile industry in India and elsewhere. It can be mixed with short staple Indian cotton, and many mills in Bombay and Ahmedabad have made successful experiments in the spinning and weaving of this new material. The Bombay Mill Owners' Association have recently requested the Tariff Board to recommend to Government the removal of the import duty on "fibro" so as to permit its wide use in this country, since, as they represent, the foreign imports of textiles manufactured from "fibro" constitute a very serious potential danger to the indigenous cotton industry. Should the production and use of "fibro" become widely established in India, it would not only do away with the necessity of increasing the cultivation of long staple cotton or of importing it from abroad, but would enable India to be self-sufficient in regard to its raw materials for the textile industry, and would also open up fresh avenues for the extended use of the forest products of the country.

#### CONCLUSION.

The instances of practical achievements in forest research given in the foregoing narrative do not all pretend to be of spectacular financial importance: they have been chosen rather to illustrate the great variety of contacts made by the Forest Research Institute with the industrial public and with other government departments in India. It is evident that these contacts result in mutual gain—sometimes large, sometimes small. But whether the immediately visible results of research appear great or small, it is incontestable that the problems investigated by the team of specialists at Dehra Dun arise from wide-spread demands for knowledge that only scientific research can provide.

The narrative is necessarily a summary. Those who wish for full details on any subject will find them in the technical papers written by the staff of the Institute; they amount to over seven hundred and are published in the *Indian Forest Records and Bulletins*, the *Indian Forester* and in other scientific journals or as separate handbooks. Government hopes that the industrial public will continue to make free use of the facilities available at the Forest Research Institute.

Enquiries should be addressed to :—

The President, Forest Research Institute,  
New Forest P. O., Dehra Dun,  
United Provinces.

